PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in the Method and Apparatus for Dredging and Cutting Channels.

I, CARL JULIUS BAER, of Planters Building, City of St. Louis, State of Missouri, United States of America, a citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to apparatus for dredging or cutting a channel in a bed of running water, and is particularly designed to provide means whereby navigable channels may be cut in beds of shallow rivers, although, as hereinafter pointed out, the invention may be effectively practised in the deeper waters. The invention also has for its purpose to remove obstructive sand bars and alluvial deposits, whereby, in certain cases, a channel is restored.

It has heretofore been proposed to accelerate the flow of the current by confining the water to a restricted path, for the purpose of making the water stir up the bed and carry off the sediment. Where the silt has become compressed into a solid mass, it has been proposed to draw scarifiers such as harrows or rakes over the bottom before deflecting the flow of water horizontally and downwardly upon the surface that was scraped. A device for horizontally and downwardly deflecting the flow consisted of at least two floats or barges having rigid guides to deflect the water horizontally between two adjacent floats, and a baffle pivoted between the floats on a horizontal axis to deflect the water downwardly.

According to the present invention the dredging or channel cutting apparatus comprises a self-propelled boat and a number of self-propelled dredging or dam units adapted to be arranged upstream of the boat to confine the running water to a restricted path and simultaneously to scrape or loosen the surface of the bed within the confines of such path. The dredging or dam units constitute a fleet which during the channel-cutting operation is pushed against the current by the boat, preferably without disturbing the relative positions of the units. The boat has wide, unobstructed decks to receive the dredging or dam units, which are transported by the boat to the scene of channel-cutting operations.

The invention is useful not only for the initial cutting of channels in large inland waterways above the existing limits of navigation, but also form forming navigable channels in tributaries; and in removing bars of sand or alluvial deposits which have partially or wholly blocked the previously formed channels, the necessary power for carrying out the major portion of the work being in all cases furnished by the force of the water of the stream, confined within certain predetermined limits.

The accompanying drawings which form a part of this specification, illustrate my invention.

In the drawings:—

Figure 1 is a detailed plan view, showing the dredging units B^1, B^2 and so on, and part of a larger unit or boat A, in position to cut a channel or to remove a sand bar;

Fig. 1^a is a perspective view of one end of the connecting bar;

Fig. 2 is a side elevation of the larger unit the forward part of which is shown in Fig. 1;

Fig. 3 is a top plan view of the larger unit shown in Fig. 1;

Fig. 4 is an enlarged detail of the propelling elements of the large unit;

Fig. 5 is a section taken on line 5—5 of Fig. 3;

Fig. 5^a is a section through one of the side plates;

[*Price* 1/-]

Fig. 6 is a detail of the method of attachment of the swinging plates as hereinafter more particularly described;

Fig. 7 is a detailed plan view, looking down on one of the smaller units.

Fig. 8 is a side elevation of the unit shown in Fig. 7;

Fig. 9 is a cross-section on line 9—9 of Fig. 7;

Fig. 10 is a detail of the traction devices used on the smaller units;

Fig. 11 is a fragmentary, partial section, taken on line 11—11, Fig. 3;

Fig. 12 is a detail showing the hinge connection of the side plates;

Fig. 13 is a fragmentary detail, showing the means for forming the single channel for certain of the slidable plates carried by the large unit, and

Fig. 14 is a fragmentary detail showing the means for forming the double channel for the slidable plates.

My method is practised by the use of instrumentalities which, for purposes of brevity, might be termed a fleet. It is composed of a large boat, A, which may be termed the mother boat, and a plurality of much smaller boats, B, which may appropriately be termed the sub boats or dredging units. The mother boat is capable of carrying on its deck, the number of smaller units necessary to perform the dredging operation in view, as hereinafter more specifically pointed out. Briefly, the mother boat carries the units to the scene of the proposed operations, when the boats are arranged in the formation shown in Fig. 1, and the operation is there completed.

The Mother Boat.

The mother boat A is shown in Figs. 1, 2, 3, 4, 5, 11 and 12. Preferably, although not necessarily, it is a barge-like structure of approximately 200 feet in length and 50 feet in width. Since most of the operations hereinafter described will be carried out in rivers of shallow waters, the mother boat is constructed with a very light draft. Such a boat, under maximum load, will draw only 36 inches of water. The boat A is equipped with propelling mechanisms 1, preferably two sets on each side, and adapted to produce a speed of 12 miles per hour, under maximum load. Suitable driving motors M, are provided for the propelling mechanisms 1, and said mechanisms are vertically adjustable, as shown in Fig. 4.

The boat A is also provided with water compartments N, and the valves V, and pumps P, necessary for varying its displacement.

The boat A is provided with a plow point or bow 4, and a stern 5, the upper surface of which tapers downwardly and outwardly at 6, to facilitate the operation of loading the smaller units B, B^1, B^2, *etc.*, thereon. The upper inclined surface 6 of the stern, is provided with a plurality of separated girders on tracks 7, 7, which may be 6 or 8 inches above the floor, and for a purpose to be hereinafter described.

The sides 8, 8, of the boat A are straight longitudinally, and extend vertically in a straight line. At the point of the merging of the sides into the pointed bow section, plates 9, 9, are pivoted, at 10, 10, one on each side of the boat. Since the two plates are duplicates, a description of one of them will suffice.

Each plate 9 is hingedly connected at 11, to a second plate 12, both plates extending downwardly, from a point above the water line, to a position such that its lower edge is somewhat above the keel 13 of the boat. As illustrated in Figs. 1 and 2, the plates are adapted to be swung outwardly away from the boat, for a purpose to be later described.

In order to swing the plates 9 and 12, I provide a shaft 14, in screw-threaded engagement with a split bearing block 15 fixed to supports 16 and 17, secured inside the boat A, as shown in Fig. 5. The shaft extends through a screw-threaded aperture centrally provided in a cog wheel 18, the hub of which is located within the split bearing block 15, ball bearings 19 being interposed to facilitate rotation of the wheel 18. Fixed to a shaft operatively connected to the boat motors, is a pinion 20, adapted to mesh with the teeth on the wheel 18, suitable clutch mechanism, not shown, being provided, whereby the gears 18, 20 may be thrown into or out of mesh, or whereby the gear 18 may be rotated forwardly or backwardly. It is obvious that by the construction shown and described, a rotation of the wheel 18 in one direction will move the shaft 14 laterally, to swing the plates towards or away from the boat, while a reverse rotation of the wheel 18 will move said shaft laterally in an opposite direction.

The shaft 14 extends through a stuffing box 21, in the side 8 of the boat A, its outer end being provided with a double-headed pin 22, riding in a slot 23, in a bracket 24, secured to the inner face of the plate 12, as clearly shown in Figs. 5 and 6. There is a shaft 14, and its operating mechanism, for each plate 9 and 12, on each side of the boat.

It will be noted in Fig. 12, that the adjoining ends of the plates 9 and 12 are pivotally connected by means of a rod 25

passing through apertured brackets 26, carried at the top and bottom of the plates 9 and 12. The rod 25 is provided with a head at its lower end, and may be secured in position at its upper end by means of a pin or nut, as will be understood.

The motors M are connected to the propelling mechanisms 1, 1, and are adapted to drive the boat, under load, at a speed of about 12 miles per hour. These motors are also connected to the shaft which rotates the pinion 20, shown in Fig. 5.

The displacement of the boat A may be varied by emptying or flooding the compartments N, N, by means of the valves V, V, and the pump P, as will be understood.

THE DREDGING BOAT.

The dredging units B, B^1, B^2, *etc.*, are exactly similar, and a description of one only will suffice. As shown in Fig. 1, they are much smaller than the boat A. Each of the units B, is provided on each side, with flat plates adapted, as hereinafter explained, for upward and downward movement. Each side of the boat is equipped with a tractor element, provided with projections which are adapted to propel the boat through the water, at a low speed; or to permit it to travel or crawl along the bottom of the water.

Since both sides of each of the dredging units are alike, a description of the tractor element on one side will suffice. Said tractor element is driven by means of a motor 29, provided with a drive shaft 30 extending lengthwise of the unit. A worm gear 31 is mounted in parallelism with said shaft 30, suitable clutch mechanism 32 being provided whereby the shaft 30 may operate said gear 31. A cog wheel 33, mounted on a shaft 34 engages the spirals of the gear 31 and is driven thereby. A sprocket wheel 35 is mounted on a shaft 36, also carrying a larger sprocket wheel 37, and a chain is provided to drive the sprocket 35 from shaft 34 at one end of the unit and an idle wheel at the other end of the unit. The tractor element 39 is formed of a plurality of connected chain links 40, as shown in Fig. 10, and said links are trained over the teeth of the wheel 37, as shown in Fig. 8. When the gear 31 is connected, through the clutch 32, to the rotating shaft 30, the tractor element 39 will be driven. Since there is a worm gear 31, and suitable clutch mechanism therefor, on each side of the unit, it is clear that the tractor 39 on one side may be idle, and the tractor 39 on the other side be moving, if desirable, in the steering operations.

The tractor element 39 runs over and under rollers 41, having trunnions 42, secured in a trough-like bracket 43, carried by the top and bottom of the compartments G and H. In certain cases the links 40 are equipped with cutting or scraping spurs 40^1.

In order to vary the displacement of the unit B, it is equipped with compartments G and H, provided with ports G^1 and H^1, controlled by valves 44, actuated by handles 45 on valve rods 46. These compartments are flooded by opening the ports G^1 and H^1 and emptied by rotary pump 47. The pump 47 is operated by means of a belt 48, trained over the pump shaft 49, and over a shaft 50 which is rotated by the motor shaft 30, through a chain 51, as shown in Fig. 9. Pipes 52 and 53 lead to the compartments G and H, respectively, and the water is exhausted through a discharge pipe 54.

Each unit B is equipped, along each side, with a front plate 55 and a rear plate 56, and with four side plates 57, 58, 59 and 60 located in a plane between the plates 55 and 56, and the body of the unit B, said plates being mounted as follows:

Extending outwardly from the body of the unit B, are brackets 59^1, 59^1, supported by struts 60^1, there being two of said brackets on each side, for each of the plates 57, 58, 59 and 60. Each of the inner plates 57, 58, 59 and 60 is provided with an inwardly extending internally-screw-threaded collar 61, adapted to receive a rotative stub-shaft 62, which is externally-screw-threaded, and which is supported in a collar 63, carried at the end of the bracket 59^1. A bevel gear 64, carried by the shaft 62, meshes with a bevel gear 65, carried by a shaft 66, the other end of said shaft 66 carrying a pinion 67. Carried by the main shaft 30 of the motor 29, is a pinion 68 carrying a chain 69 engaging the teeth of a gear 70, mounted on a stub shaft 71; a chain 71^1 connects the pinion 67 to the gear 70 carried by the shaft 71, and a chain 72 rotates the shaft 66. Suitable clutch mechanism is provided at 73, whereby to clutch and unclutch the gear 70.

From the foregoing it will be seen that rotation of the shaft 30 in one direction will, through the instrumentalities described, operate to raise the plate 60, while rotation of said shaft in an opposite direction will lower said plate. It will be noted that there are two brackets 59^1 for each of the plates, the brackets being so disposed that the plates are caused to slide upwardly and downwardly in a

straight vertical line, without any tilting movement.

In order to guide the plates 57, 58, 59 and 60, in their vertical movements, I provide guideways 74, such as indicated in Figs. 13 and 14. The end guideways 74 is provided by the angle iron end 75 of the boat, to which is secured an angle iron 76, as indicated in Fig. 13. Fig. 14 shows guide ways for two plates, formed of two angle irons 77 and 78, and 77^1 and 78^1 respectively, as will be understood. As indicated, the angle iron members are carried by the outer side of the compartments G and H of the boat.

The plates 55 and 56 are supported by headed pins 79, connected to the plates 57 and 60, as shown in Figs. 8 and 9, and by headed pins 80, secured to the walls of the compartments G and H, and projecting outwardly therefrom, between the angle irons 77 and 77^1, and 78 and 78^1, as clearly shown in Fig. 14. Each plate 55 and 56 is provided with a longitudinally extending slot 81, about midway of its side, and adjacent the top, said slot being adapted to receive the pin 79. By means of this construction, lateral movement of the plate 56, with respect to its associated plate 60, is permitted.

Adjacent each side of each of the plates 55 and 56, are two inclined slots 82, which receive the headed pins 80, as clearly shown in Fig. 8. Since the slots 82 are inclined, and the pins 80 rigid, it is obvious that any downward movement of the plate 56 would cause it to move simultaneously to the right, from the position shown in Fig. 8, and any upward movement, from the lower position just referred to, would result in an inward movement to the left, tending to restore the plate 56 to the position shown in Fig. 8.

From the foregoing description it will be clear that, since the plate 56 is secured to the plate 60, by the pin 79, and thereby held against vertical movement with respect to said plate 60, any vertical movement of the latter plate will effect a corresponding vertical movement of the former, while at the same time, a lateral movement of the plate 56, with respect to the plate 60 is being effected through the medium of the inclined slots 82 and the fixed pins 80. The extent of lateral movement of the plate 56 is determined by the length of the slot 81, while the vertical movement thereof is fixed by the vertical distance between the top and bottom of the slots 82.

The mechanisms furnishing the power whereby the plates are lowered and raised, and the plates 55 and 56 simultaneously and automatically projected and retracted, have already been described. The purpose of this movement of the plates will presently appear. It may here be stated that the so-called "pins" will, in commercial usage, be of sufficient strength to properly support the plates 55 and 56, and that where necessary, antifriction bearings will be positioned between the pins and the contacting walls of the slots, to insure ease and certainty of operation.

THE CHANNEL CUTTING OPERATION.

Having described the main units to be employed, I shall now describe the operation of said units in their employment for the purpose of cutting the desired channel.

It having been determined where a channel is to be cut, or a sand bar impediment removed, the necessary number of the units B, are taken on board the mother boat A, being positioned as shown in Fig. 3. In loading the boat A with the units B, the latter are allowed, under their own power, to climb upwardly on the incline 6 along the tracks 7 of the boat A. The first of the units B, B^1 and so on passes through the arches 3 of the boat A, until the desired number is on the front end of the boat, and the remaining units are so distributed as to properly trim the boat A. In Fig. 3 I have shown ten units aboard the boat A, but another unit, if necessary, could be positioned in the arch 3.

The loaded boat A is now navigated to the scene of operation, and the units B, under their own power, are run down the tracks 7 into the water, and formed into a dredging or channel-cutting battery, and straddling the line of the proposed channel, or the bar which it is desired to remove. The consistency of the bottom of the river is a factor which enters into the question of the use of the scrapers 40^1. The arrangement of the battery may be as follows:

Enough of the units B to cover the width of the proposed channel, or of the bar to be removed, are arranged side by side, pointing up stream. In Fig. 1 I have chosen to show two units B^1 and B^2 in this position, both said units being here shown as equipped with the scrapers 40^1. Adjacent one side of each of the units B^1 and B^2, and secured thereto, are other units B^3 and B^4, not equipped with the scrapers. Connected to the outer side of the front end of the units B^3 and B^4, are additional units B^5 and B^6 arranged in alignment as shown.

The boat A is secured to the rear end of each of the units B^1, B^2, by means of rigid bars 83, as shown in Fig. 1, the

prow of the boat being positioned centrally between the two units. To each side of the inclined prow of the boat A, is secured a unit B^7, equipped with scrapers 40^1.

With the boat A and the units in the position described, over the line of the proposed dredging operation, the several units may be partially submerged, by opening the valves 44, until the tractor elements rest upon the bottom of the river the side plates 57, 58, 59 and 60 being dropped to the lowest positions, and the plates 55 and 56, being automatically projected forwardly and rearwardly, respectively. By the instrumentalities heretofore described, the boat A is sunk until it touches the bottom and the plates 9 and 12 are swung outwardly from the boat A, as shown in Fig. 1, in line with the inclined sides of the prow, and all the units B and the boat A are started upstream, crawling along the bed of the river, under their own power.

As many of the pulling and water deflecting units B^5 and B^6 as necessary may be provided, and it is to be noted that each of the rows of these particular units is inclined outwardly from the connected unit B^4 or B^3 presenting, between the front units B^5 and B^6, a relatively large opening to receive the water which is traveling in opposition to the direction of travel of the units. As shown in Fig. 1 however, the rear plates 56 of each unit overlap the front plates 55 of the connected unit, effecting a sufficient water seal to force the water inwardly towards the central scraping units B^1 and B^2. The water is therefore restricted to relatively small path beneath the units B^1 and B^2, and its velocity and scouring ability greatly increased. In the meantime the scrapers 40^1, carried by the tractor elements 39, of the units B^1, B^2 and B^7, are actively engaged in scraping and digging up the bed of the river. The water, rushing with high velocity beneath the units B^1 and B^2, carries with it the mud, sand and other alluvial deposits dislodged by the scrapers 40^1 and the other tractor elements, and projects such deposits against each side of the pointed bow of the boat A, whence they are deflected beneath the units B^7. It is to be noted that the side plates of the units B^7 are also lowered, and that the scrapers 40^1 are also agitating the bed of the river. Consequently the water rushes under these units, and is led to the tapering bow of the boat A, and thence to the outspread side plates 9 and 12, which conduct the water, and the mud, sand and alluvial deposits carried thereby, away from the line of the channel which has already been cut, thereby preventing refilling thereof by such deposits.

By the use of the units as described the force of the water is utilized, not only to remove and carry off, laterally of the channel being cut, such deposits as have been disturbed by the tractor elements, but also to dislodge, by reason of the velocity and force of the water, additional strata of deposits not reached by the tractor elements.

The boat A, following the several units, rides in the channel which has been cut, and, since the boat is approximately 200 feet long, it serves to sufficiently prevent eddying particles of deposit from settling in the cut channel behind the rear of said boat. The boat is being propelled under its own power by the propelling mechanisms 1, which, dependent upon the existing conditions, may be raised free of the bottom of the river, or may engage the bottom. Furthermore, the connections 83, between the boat A, and the units B^1 and B^2, and the connections 84, between the units B^3 and B^5, and B^4 and B^6, are preferably rigid bars, whereby against a very swift current, the extremely high power of the boat A may be utilized, if necessary, to assist in pushing the several dredging units.

The units B^1 B^2 B^3 and B^4 are rigidly connected, by a strong bar 85, whereby they are held in alignment. A section of said bar is shown in Fig. 1^a, provided with apertures to receive projections carried by the units, whereby the distances between said units may be fixed, as desired.

In proceeding upstream, the pulling units B^5 and B^6 may, if necessary, be connected by a cable 86, to prevent lateral separation or spread, but, since mechanism is provided whereby one set of the tractor elements of the units B may be run at a different speed from that of the other set, in order to prevent such spread of the outer units B^5 and B^6, the outside tractor elements of each may be run at a higher speed than that imparted to the tractor elements on the other side of said units. Manifestly this difference in speed of the tractor elements on opposite sides of a unit, would have the tendency of overcoming the outward thrust of the water being trapped between the units B^5 and B^6.

From the foregoing it is obvious that by the manipulation of the boat A, and the several units B as described, the fleet may very easily be taken to the scene of operation, quickly manœuvred into operative position, and that the instrumentalities will readily force the running water to cut its own channel, ably assisted by

the tractor elements carried by the several units B.

The battery or fleet may be operated in extremely shallow water, since the propelling mechanism 1, of the boat A, are capable of being lowered to engage the bottom of the river, and to thereby crawl along the bottom until deeper water is encountered, or until it reaches the scene of operation. In case the boat A should become grounded, so that it could not free itself under its own power, several of the units B could be taken off the boat A, and connected thereto, and could drag it into deeper water, or to the scene of operation.

It is well to mention the fact that two complete batteries or fleets are operable in conjunction to effect the dredging operations heretofore described. In other words, another of the boats A, and additional units B, may be advantageously used to supplement the devices hereinbefore referred to. By the use of the two boats A, and two complete complements of units B, one battery could be used to quickly rough-cut the channel, and the other battery could follow immediately thereafter and complete the channel. Or, when necessary, certain of the units B, carried by the second boat A, could be added to the water deflecting units B^5 and B^6, or to the channel cutting units B^1, B^2, and B^7, whereby to present a wider wing dam spread in the one case, and trap more water, and to cut the river bed for a wider channel, in the other case. In both the above referred to instances, the boats A, A, would follow behind the units. If a wider channel were being cut, the boats A, A, would be side by side, and fastened together against lateral separation, the bows of the boats being connected to the cutting units B^1 B^2 by the bars 85, while deflecting units B^5, B^6, are connected by the bars 84, with the units connected to the mother boats and a unit B^7 is positioned on each side of the tapering prow of each of the boats A, the buoyant plates 9 and 12 of the outer side of each boat, being spread outwardly. The great power of both boats A could be utilized in pushing the fleet forward.

If only one set of the cutting units B^1 *etc.*, were used, and a double set of the water deflecting units B^5 and B^6 were used, the two boats A, A would be arranged in alignment, the prow of the rear boat being connected by a bar 85 to the stern of the forward boat, as will be understood, and a water-deflecting unit B^7 positioned on each side of each prow, the plates 9 and 12 on each side of each boat being spread outwardly.

As shown in Fig. 5ª, the plates 9 and 12, are composed of two elements connected by bolts, and forming a hollow, water-tight shell, which is filled with cork or other material adapted to render the plates buoyant. The provision of the cork filling, whereby the plates are made buoyant, prevents any objectionable tilting tendency, when the plates are projected outwardly, as will be understood. All of the water-deflecting plates of the units B, may be similarly constructed, if found necessary.

It is manifest from the foregoing that so long as any running water is in the river, the desired channel could be cut, either by propelling the boat A and the units B through the water, or along the bottom thereof, or both. It is also clear that the water-deflecting units B^5 and B^6, constitute self-movable wing dams.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Apparatus for dredging or cutting a channel in a bed of running water, comprising a self-propelled boat and a number of self-propelled dredging or dam units adapted to be arranged upstream of the boat to confine the running water to a restricted path and simultaneously to scrape or loosen the surface of the bed within the confines of such path.

2. Apparatus according to Claim 1, in which the dredging or dam units constitute a fleet which during the channel-cutting operation is pushed against the current by the boat, preferably without disturbing the relative positions of the units.

3. Apparatus according to Claim 1 or 2, in which the boat has wide, unobstructed decks to receive the dredging or dam units, which are transported by the boat to the scene of channel-cutting operations.

4. Apparatus according to Claim 1, in which the boat and the units are adapted to travel through the water or along the bottom thereof, and are provided with means for varying their respective displacement.

5. Apparatus according to Claims 1 to 4, in which the boat and the units have deflector means adapted to be moved from normal position to turn running water from its normal path.

6. Apparatus according to Claims 1 to 5, in which the boat functions as a material factor in temporarily maintaining the channel as it is cut.

7. Apparatus according to Claim 5, in which the deflector devices on the boat

are adapted to be swung outwardly by means driven from the propulsion motor of the boat.

8. Apparatus according to Claims 5 and 7, in which the deflector devices consist of wings or the like comprising hollow plates filled with buoyant material such as cork, there preferably being on each side of the boat one wing pivoted to the side of the boat and a second wing pivoted to the first wing.

9. Apparatus according to Claim 7 or 8, in which each deflector carries a slotted bracket in which is slidably connected the end of a threaded shaft which passes through the side of the boat and engages in a threaded bearing adapted to be rotated by the motor.

10. Apparatus according to any of Claims 1 to 9, in which each dredging or dam unit is provided along its sides with vertically and laterally movable water-deflecting members or plates.

11. Apparatus according to Claim 10, in which the water-deflecting members are provided adjacent the ends of the units and are so connected to intermediate vertically-movable members or plates that the movement of the latter automatically imparts the desired movement to the former.

12. Apparatus according to Claim 11, in which each member adjacent the ends of the unit has a horizontal slot and an inclined slot receiving pins carried by the vertically movable member.

13. Apparatus according to Claims 10 to 12, in which the vertically and laterally movable members are projectible beyond the ends of the unit.

14. Apparatus according to any of Claims 10 to 13, in which the movement of the water-deflecting members is effected by the source of power which drives the devices for scraping or loosing the surface of the channel to be cut.

15. Apparatus according to Claim 11 & 14, in which the vertically movable members or plates are mounted in guide ways carried by the sides of the unit and have screw threaded collars surrounding shafts connected to the unit motor.

16. The improved method of and apparatus for dredging or forming a channel in a bed of running water, substantially as hereinbefore described and illustrated with reference to the accompanying drawings, for the purpose specified.

Dated this 6th day of August, 1924.

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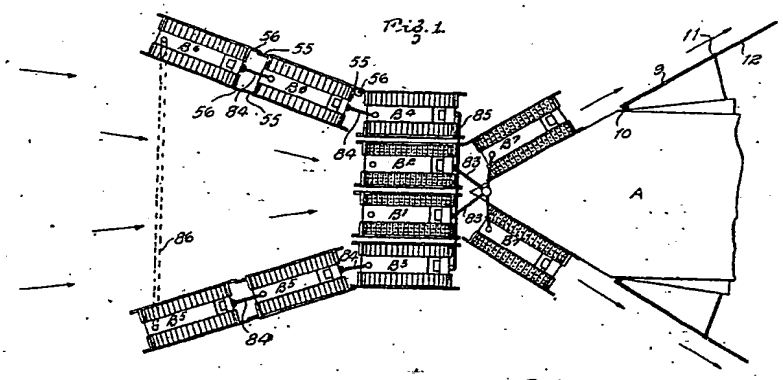

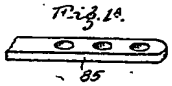

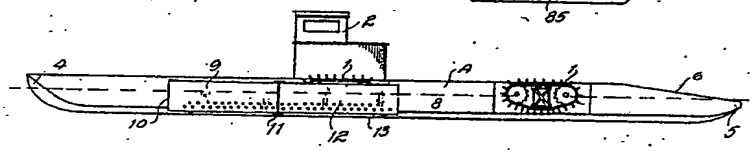

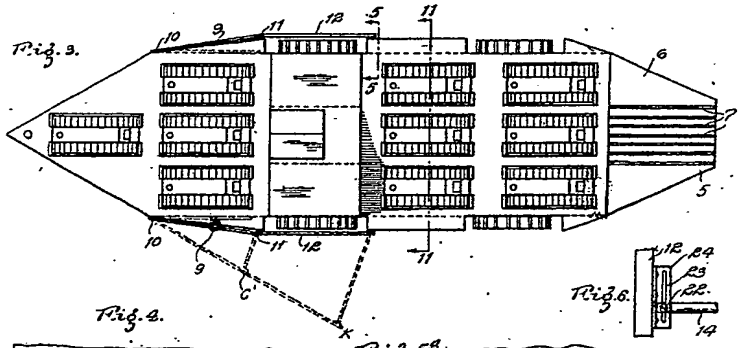

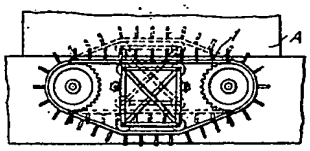

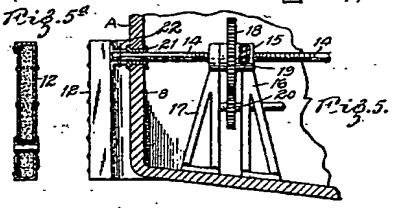

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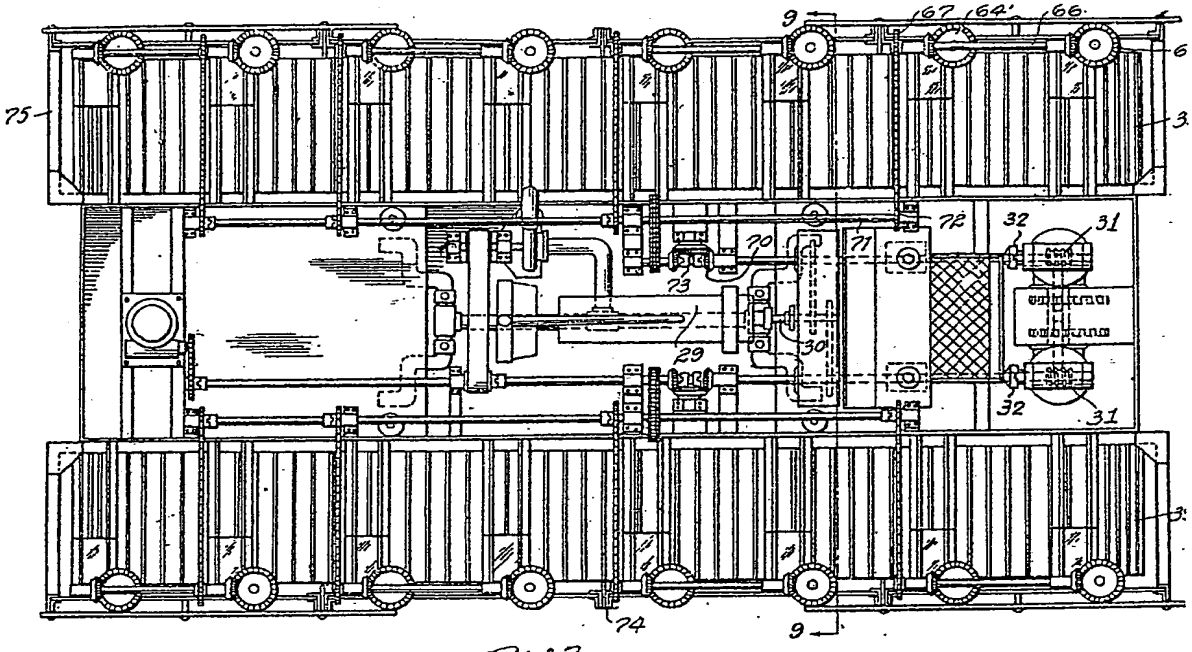


Fig. 7.

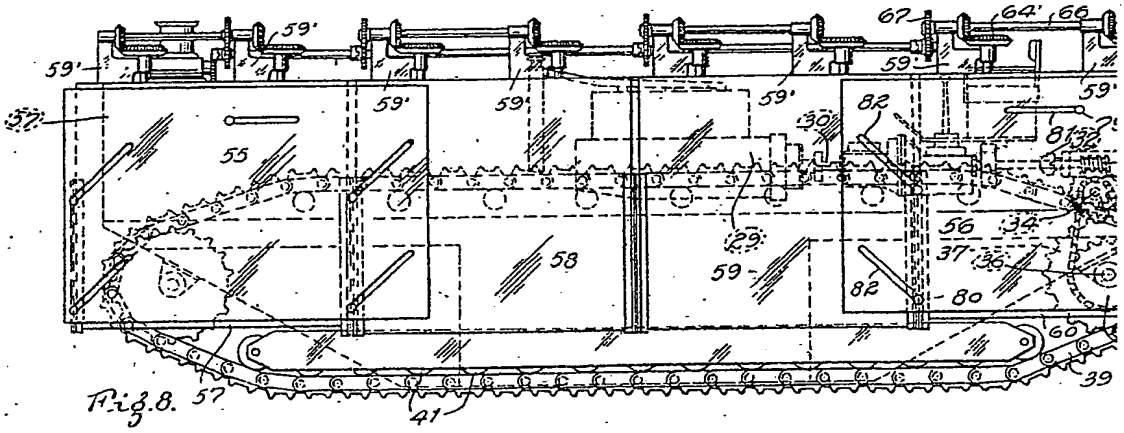
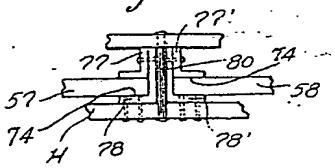


Fig. 8.

Fig. 14.



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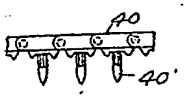
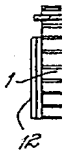
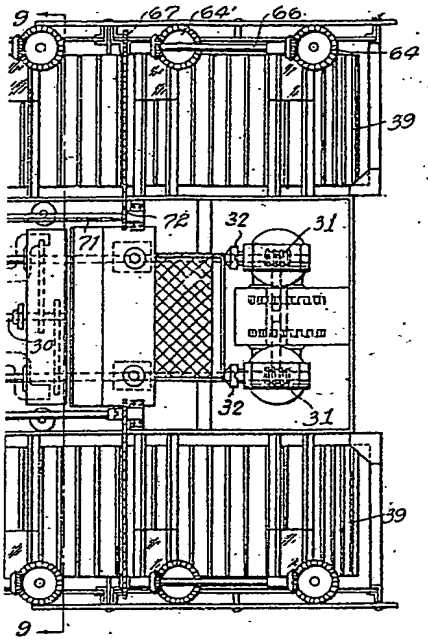






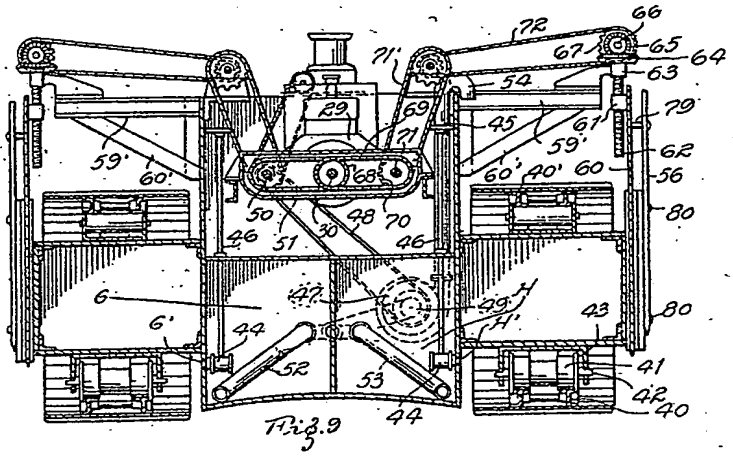


Fig. 9

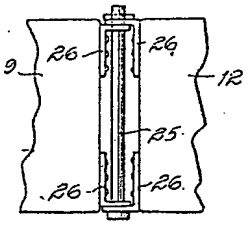
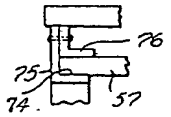
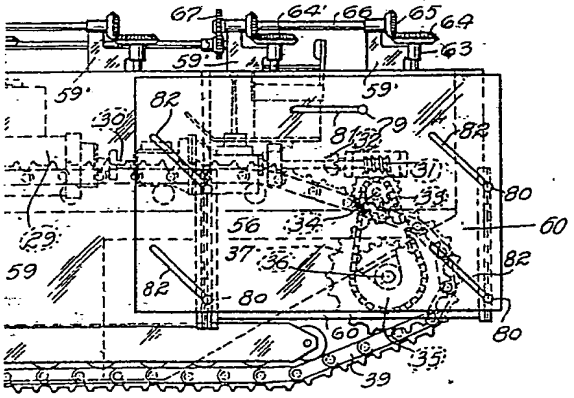


Fig. 12.

Fig. 13.





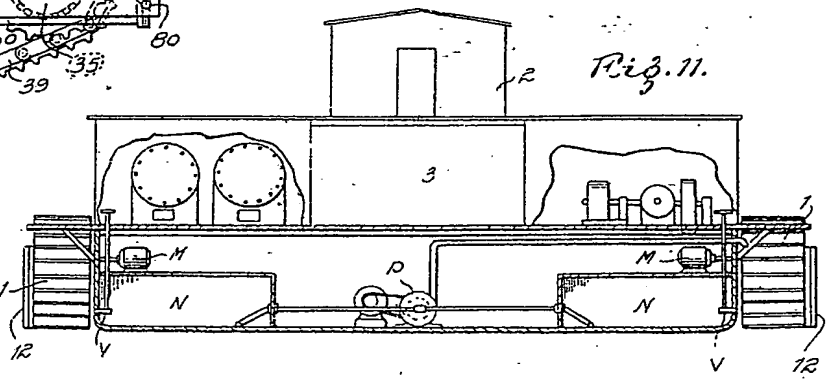
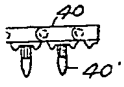


Fig. 11.

Fig. 10.



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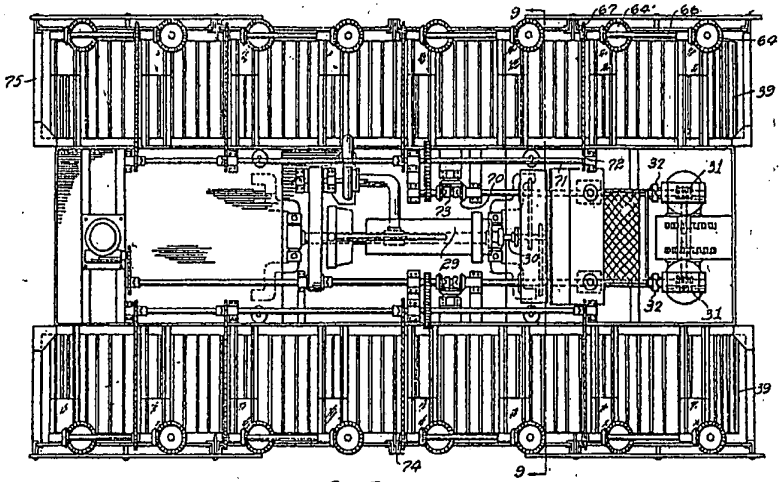

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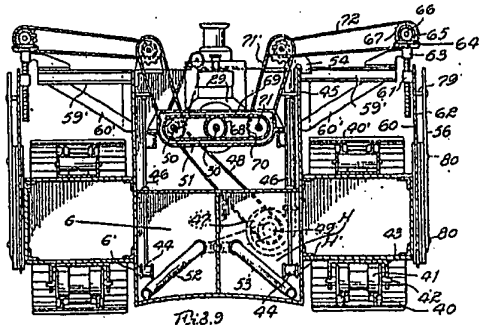

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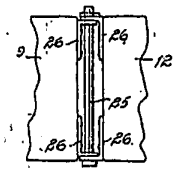

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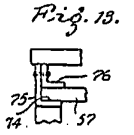

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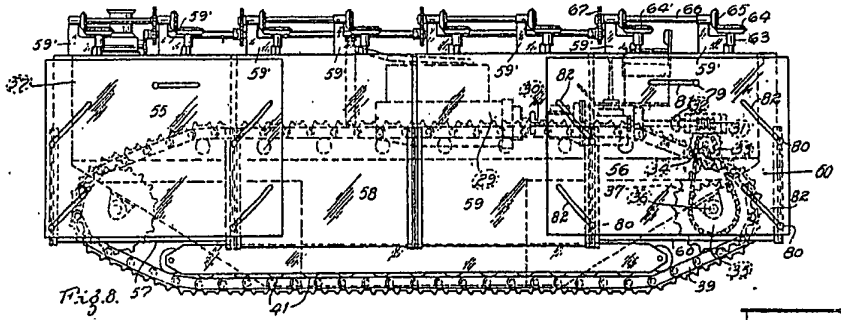

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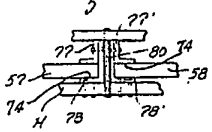

Fig. 14.

Fig. 10.

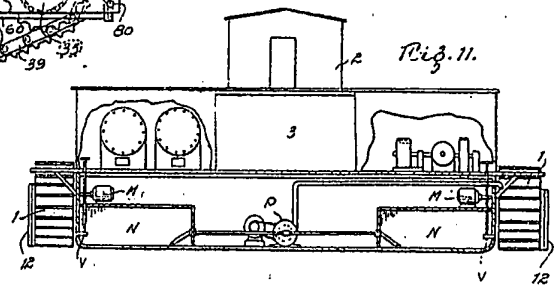

Fig. 11.

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